

**WATERMAIN SPECIFICATIONS
W200**

Rochester, MN

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Section 1 GENERAL REQUIREMENTS

W200.101 Description

These specifications shall apply to the construction and repair of watermain utilizing plant fabricated pipe and other appurtenant materials, installed for conveyance of potable water. The work includes the relocation or adjustment of existing facilities as may be specified in the contract.

All references to cast iron material shall be construed to include Gray Iron and Ductile Iron products, except where one or the other is specified. All references to "structure" shall include any manmade object that is not otherwise accepted by special terminology or definition.

The City of Rochester reserves the right, at any time during the construction of any watermain embraced within the limits of a public contract, to issue a permit to a property owner to connect premises to the watermain. In the event such a permit is issued, the Contractor is not relieved of the responsibility to complete the contract according to Plans and Specifications. The issuance of a permit by the City to tap or connect to any part of a watermain embraced within the limits of a public contract shall in no sense be construed as acceptance of any part of the work.

W200.102 Reference Documentation

Provisions of the General Conditions and Trench Excavation & Backfill/Surface Restoration shall apply to this work. The Contractor shall abide by the applicable provisions of state, federal and local laws and ordinances.

All references to Mn/DOT Specifications shall mean the latest published edition of the Minnesota Department of Transportation Standard Specifications for Construction as modified by any Mn/DOT Supplemental Specifications issued before the date of advertisement for bids. All references to Specifications of AASHTO, ASTM, ANSI, AWWA, etc. shall mean the latest published edition available on the date of advertisement for bids.

The following American Water Works Association (AWWA) Specifications have been referenced in this Specification:

- C104 Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
- C105 Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
- C111 Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- C150 Standard for Thickness Design of Ductile-Iron Pipe
- C151 Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
- C153 Standard for Ductile-Iron Compact Fittings, 3 In. Through 24 In. (76 mm Through 610 mm) and 54 In. Through 64 In. (1,400 mm Through 1,600 mm), for Water Service
- C500 Standard for Metal-Seated Gate Valves for Water Supply Service (Includes addendum C500a-95.)
- C502 Standard for Dry-Barrel Fire Hydrants (Includes addendum C502a-95.)
- C509 Standard for Resilient-Seated Gate Valves for Water Supply Service (Includes addendum C509a-95.)
- C600 Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
- C651 Standard for Disinfecting Water Mains

Section 2 MATERIALS

W200.201 General

The Engineer and Engineer's authorized representatives shall have free access to the manufacturing or processing plants for the purpose of making appropriate inspections and tests. The Contractor shall furnish an affidavit from the manufacturer to the effect that all tests have been made and that the pipe, fittings, and specials conform to the Specifications.

All pipe, fittings, and specials shall be subject to further inspection and approval by the Engineer before being used in the work. At the request of the Engineer, the Contractor shall furnish without charge [for test purposes] up to 0.5% of the number of pipe in each size of pipe furnished to be used for test purposes. In no case shall less than one full length of pipe or one complete fitting of each size be furnished.

W200.202 Ductile Iron Pipe (D.I.P.)

Ductile-Iron Pipe shall meet the requirements of ANSI A-21.51 (AWWA C151) for "Ductile-Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds, for water or Other Liquids."

Wall thickness for Ductile-Iron Pipe shall be determined in accordance with the ANSI A-21.50 (AWWA C150) "Thickness Design of Ductile Iron Pipe." In no case shall pipe wall thickness be less than Class 52.

Pipe shall be furnished with a cement-mortar lining produced in accordance with ANSI A-21.4 (AWWA C104) "Cement Mortar Lining for Cast Iron Pipe and Ductile-Iron Pipe and Fittings for Water."

Pipe joints shall meet the requirements of ANSI A-21.11 (AWWA C111) for "Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings."

Pipe joints shall be push-on type unless otherwise specified.

Pipe shall be installed so as to provide electrical conductivity through the use of either a copper strip conductor across each joint or a conductive gasket equal to the American Fastite conductive gasket or approved equal.

Pipe shall be furnished in nominal laying lengths. Cut pipe will be accepted; however, the total length of cut pipe incorporated into the job shall not exceed 10% of the estimated length of ductile iron watermain pipe as shown on the proposal. The nominal laying length of cut pipe shall be within $\pm 1'$ of the nominal laying length of pipe otherwise furnished. Installation of used pipe will not be permitted unless authorized by the Engineer in writing.

Each length of pipe shall be marked with the weight, thickness, class designation, manufacturer's mark and year in which the pipe was cast.

W200.203 Polyethylene Encasement

Polyethylene encasement material shall conform to the requirements of AWWA C105 for tube type installation and 8-mil nominal film thickness.

W200.204 Ductile Iron Fittings and Specials

Ductile iron fittings and specials shall be of the single gasket push-on joint or the Mechanical Joint (M.J.) type conforming to AWWA C153 and ANSI A-21.53 covering ductile iron compact fittings for 350 psi water pressure plus water hammer. The single gasket push-on joint and mechanical joint shall conform to ANSI A-21.11. Cement mortar lining will not be required unless otherwise stated in the Special Provisions.

W200.205 Isolation Valves

Unless otherwise specified in the Plans or Special Provisions, isolation valves shall be resilient seated gate valve type, with non-rising stem, ductile iron body and fusion-bonded epoxy coating on interior and exterior surfaces.

Resilient seated gate valves shall have mechanical joint ends or single gasket joint type ends and be designed to operate under 200 pounds working pressure and shall conform to the requirements of AWWA C-509. Valves are to open counter-clockwise. Valves are to be furnished with stainless steel bonnet bolts and nuts and shall not have test plugs.

W200.206 Tapping Sleeves and Valves

The tapping valve shall meet the same requirements as the previously described resilient seated gate valves except the inlet flange shall meet ANSI B-16.1 for Cast Iron Pipe Flanges, Class 125. The tapping sleeve shall have mechanical joint ends and ANSI Class 125 flange complying with AWWA C500.

W200.207 Cutting in Sleeves

Cutting-in sleeves are not permitted. Only mechanical joint solid sleeves with retainer glands shall be used for pipe cut-ins (one per cut-in). Stainless steel repair sleeves shall not be used for this application.

W200.208 Valve Boxes

Valve boxes shall be the screw type, have a minimum inside shaft diameter of 5 1/4", and have a cap with the word "WATER" plainly marked on top. In all respects the valve box shall be equal to Tyler 6860 Series. The American Flow Control high-density polyethylene trench adaptor will be considered an approved equal.

The valve box assembly shall be furnished in such lengths of sections needed to satisfactorily complete the installation to the desired height without field cutting either the center or top section of the box.

W200.209 Hydrants

All hydrants shall be of a standard make and shall be designed to safely hold a working pressure of 150 lbs per square-inch, and not cause "water hammer" with extraordinary usage. Hydrants shall be of the Non-Jacket Type and shall further be of such design that if the hydrant is broken off, the valve will remain closed.

Hydrants shall be Waterous (Pacer WB-67) or U.S Pipe & Foundry (Metropolitan Snow Country 250) meeting the following specifications:

1. Ductile iron body
2. All bronze drain
3. 5-1/4" valve opening
4. 6" mechanical joint connection
5. Two 2-1/2" National Standard Thread hose connections
6. One 4" Rochester Standard Steamer Thread hose connection
7. 1-1/2" National Standard operating nut (Pentagon), counter-clockwise turn to open
8. Twist-in mechanically attached nozzles
9. Traffic break-off, 24" minimum distance from ground to centerline of nozzle
10. Minimum working pressure - 150 psi
11. Hydrostatic test pressure - 300 psi
12. Bronze seat ring insert

13. International Orange Epoxy Coating, 6.0 mil minimum total coating dry film thickness

14. Compliance with AWWA C502

Unless otherwise specifically directed by the Engineer, the hydrant assembly shall be furnished in the length needed to satisfactorily complete the installation to the desired height without the use of "Bonds" or "Offsets." In cases deemed necessary and authorized by the Engineer, "Hydrant Extensions" may be used. No additional compensation will be allowed for furnishing and installing such fittings.

W200.210 Materials for Restraining Joints

A. Tie Rods (use only for restrained joints connecting to existing watermain)

Tie rods and clamping devices used for rodding at fittings shall be of the required size and adequate strength to secure the installation from movement. The rod size and clamping arrangement shall be as indicated on the Plans or Detail Plates for Watermain Tie Rods and Clamping Devices.

Tie rods shall be galvanized, and other clamping devices shall be epoxy-coated.

All such materials shall be approved by the Engineer before being used in the work.

B. Retainer Glands (use for restrained mechanical joints)

Mechanical joint retainer glands shall be Mega lug Retainer Glands as manufactured by EBAA Iron, Inc. or approved equal.

C. Single Gasket Restrained Joints

Single gasket restrained joints shall be American Fastite type with Fast-Grip gaskets, US Pipe Tyton Field Lok or approved equal. Electrical conductivity is to be maintained across all single gasket pipe joints.

W200.211 Miscellaneous Materials

Any other miscellaneous material required in the work not specifically mentioned in these specifications, shall be new, unused, undamaged, and of a quality equal to the materials specified herein and shall be submitted to, and approved by, the Engineer prior to its use.

Section 3 CONSTRUCTION REQUIREMENTS

W200.301 General

A. Designation of Authority

The City Engineer or authorized representative shall be the designated authority for all watermain construction and inspection, except Hydrostatic bacterial and conductivity testing will be accomplished with oversight from Rochester Public Utilities.

B. Handling Pipe and Accessories

Pipe, fittings, valves, hydrants, and other watermain accessories shall be loaded, transported, unloaded, stored, handled, and installed by methods and in a manner that will insure their final installation in a sound and undamaged condition conforming in all respects to specified requirements.

Under no circumstances shall the pipe, fittings, valves, or hydrants be dropped to the ground, onto or against hard or solid objects or materials, or otherwise subjected to possible damage from impact or shock. Such materials shall be loaded and unloaded by lifting with hoists or by skidding. Pipe handled on skidways shall not be skidded or rolled against other pipe.

In distributing pipeline material at the site of the work, each piece shall be unloaded opposite, or as close as possible to, the point of installation in order to avoid unnecessary rehandling.

C. Work Schedule and General Requirements

When street grading is also under contract on the project, the Watermain Contractor shall install the main immediately after the rough grading is completed. Upon completion of the underground work the Watermain Contractor shall restore the roadway to the same condition as it was prior to trenching.

If the Watermain Contractor chooses to make the installation prior to the rough street grading, he shall place not less than 4' of earth fill over the watermain.

All supplies, tools, and equipment necessary to the proper construction and satisfactory completion of the work in accordance with the Specifications are to be furnished by the Contractor. It is understood that the whole work under this contract is to be done at the Contractor's risk, and that he is to assume the responsibility and risk of all damages to the work, or to the property on the line of the work, which may be occasioned by floods, backwater, caving of the street, settling of the foundations of buildings, or from any cause whatsoever. The Contractor shall not dig up or occupy with materials any more of the street than is absolutely necessary for the prosecution of work, and in no case shall the operations extend beyond the limits of the right-of-way or easement lines. Special care shall be taken to cause a minimum of inconvenience to persons residing along the line of improvement. The Contractor shall protect all excavations by barricades, lights, and other warning devices. The Contractor shall also provide for the flow of all watercourses, sewers, gutters, and drains, and provide for the protection of other utilities, both public and private.

W200.302 Placing Watermain and Appurtenances

A. General

Installation of piping and appurtenances shall be in compliance with AWWA C600 and the project Plans, Specifications, and Special Provisions. Piping and appurtenances shall be laid to the required line and grades as outlined below, each section having a firm and uniform bearing throughout its entire length.

B. Grading and Aligning Pipe

The Contractor is solely responsible for the correct transfer of the primary line and grade from the Engineer's stakes to all working points, and for construction of the work to the prescribed lines and grades

C. Installation of Pipe, Fittings, and Polyethylene Encasement

1. Care in Handling

All pipe, fittings, and specials shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, or other suitable means, in such a manner as to prevent damage to the watermain materials or to the coating thereon. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

Before lowering and while suspended, the pipe shall be inspected for defects, and any defective, damaged, or unsound pipe shall be rejected.

Dropping, jolting, striking, or other such methods of manipulating pipe to proper grade and alignment will not be permitted.

2. Direction of Laying

Unless otherwise directed, pipe shall be laid with bell ends facing in the direction of laying.

3. Cleaning, Swabbing, and Chlorine Treatment

All foreign matter or dirt shall be thoroughly removed from the inside of the pipe before it is lowered into its position in the trench, and it shall be kept clean by approved means during and after laying.

A mechanical joint or slip-on joint plug shall be inserted into the bell of the last pipe laid when work is suspended overnight and for seasonal suspension of work.

Immediately before each length of pipe and each fitting is installed on the new watermain, the outside of the spigot end of the pipe, the inside of the pipe barrel and bell, and the interior surfaces of the fittings shall be thoroughly swabbed with a calcium hypochlorite solution containing not less than 200 parts per million of chlorine. "H.T.H." or an equivalent bactericidal agent may be used for this solution.

In addition, the "Dry Calcium Hypochlorite Method" of disinfecting the watermain shall to be used (AWWA C651). Dry calcium hypochlorite (containing at least 65% available chlorine) shall be placed in the pipe during placing operations. A minimum of one ounce shall be placed in each length of 4-inch through 10-inch watermain and one and one-half ounces for each length of 12-inch and larger watermain.

4. Joining Single Gasket, Slip-on Pipe

Immediately prior to assembling the joint, the rubber gasket and all surfaces of the bell and spigot shall be cleaned of dirt, rust or other foreign material. If a copper jumper strip is being installed instead of a conductive gasket, line up the jumper strip. Before drawing the pipe together, the spigot end of the gasket shall be coated with a light film of approved lubricant. If a copper jumper strip is being installed instead of a conductive gasket, after drawing the pipe together, connect the copper jumper strip.

5. Joining Mechanical Joint Pipe

Immediately prior to assembling the mechanical joint, the rubber gasket and all surfaces of the bell, spigot, and gland which will come in contact with the gasket shall be thoroughly cleaned of any dirt, rust or other foreign material. . If a copper jumper strip is being installed instead of a conductive (armor tipped) gasket, line up the jumper strip. Where necessary, the gasket may be

coated with a light film of an approved lubricant to facilitate slipping over the spigot end and into the bell.

After the gland has been shoved into place against the gasket, the bolts shall be inserted, and the nuts shall be tightened with the fingers until snug. Tightening of bolts shall be done carefully and evenly, alternately tightening opposite bolts in order to maintain approximately the same distance between the gland and the pipe flange at all points around the circumference of the joint.

Final tightening of the bolts shall be done with a ratchet torque wrench unless otherwise permitted by the Engineer. Torque requirements shall be in accordance with the following table:

Size of Bolt	Torque Foot-Pounds	*Length of Wrench
$\frac{5}{8}$ "	40 – 60	8"
$\frac{3}{4}$ "	60 – 90	10"
1"	70 – 100	12"
1 $\frac{1}{4}$ "	90 – 120	14"

* (The wrench lengths stipulated in this column are required lengths of non-torque wrenches to be used in the event that their use is permitted by the Engineer.)

After tightening the bolts, connect the copper jumper strip.

6. Cutting Pipe

Cutting of pipe for closure pieces, for installation of valves, hydrants, and fittings, or for any other reason shall be done in a neat and workmanlike manner without damage to the pipe or cement lining therein and so to leave a smooth cut end at right angles to the axis of the pipe. Unless otherwise approved by the Engineer, all cutting of pipe shall be done by means of mechanical pipe cutters of an approved type, except that the cutting of pipe already in place where the use of mechanical cutters would be difficult or impracticable, may be done with diamond point chisels or other hand tools which will cut the pipe without damaging impact or shock.

7. Polyethylene Encasement

Wherever so required by the Plans, Specifications, or Special Provisions, the pipeline, including valves, fittings, and appurtenances, shall be fully encased in polyethylene film meeting the requirements of these Specifications and City Standard Detail Plate 6-06. The film shall be furnished in tube form for installation on pipe and all pipe-shaped appurtenances such as bends, reducers, offsets, etc. Sheet film shall be provided and used for encasing all odd-shaped appurtenances such as valves, tees, crosses, etc.

The polyethylene tubing shall be installed on the pipe prior to being lowered into the trench. Tubing length shall be sufficient to provide a minimum overlap at all joints of one foot or more. Overlap may be accomplished with a separate sleeve tube placed over one end of the pipe prior to connecting another section of pipe, or by bunching extra overlap material at the pipe ends in accordion fashion. After completing the pipe jointing and positioning the overlap material, the overlap shall be secured in place with plastic adhesive tape wrapped circumferentially around the pipe not less than three turns.

After encasement, the circumferential slack in the tubing film shall be folded over at the top of the pipe to provide a snug fit along the barrel of the pipe. The fold shall be held in place with plastic adhesive tape applied at intervals of approximately three feet along the pipe length. Also, any rips, punctures, or other damage to the tubing shall be repaired as they are detected. These repairs shall be made with adhesive tape and overlapping patches cut from sheet or tubing material.

At odd-shaped appurtenances such as gate valves, the tubing shall overlap the joint and be secured with tape, after which the appurtenant piece shall be wrapped with a flat film sheet or split length of tubing by passing the sheet under the appurtenance and bringing it up around the body. Seams shall be made by bringing the edges together, folding over twice, and taping down. Wherever encasement is terminated, it shall extend for at least two feet beyond the joint area.

Openings in the tubing for branches, service taps, air valves and similar appurtenances shall be made by cutting an X-shaped slit and temporarily folding back the film. After installing the appurtenance, the cut tabs shall be secured with tape and the encasement shall be completed as necessary for an odd-shaped appurtenance.

Unless otherwise specified in the Plans, Specifications, and Special Provisions, hydrants encased in polyethylene tubing shall have plugged drain outlets.

8. Setting Valves, Fittings and Valve Boxes

Gate valves and pipefittings shall be set and jointed to the pipe in the manner heretofore specified for cleaning, laying and jointing pipe. Valve boxes shall be firmly supported and maintained, centered, and plumbed over the wrench nut of the gate valve, with the box cover at such elevation as directed by the Engineer.

All valves and fittings shall be installed with restrained joints conforming to the requirements of W200.210.

9. Setting Hydrants

Hydrants shall be placed as shown on the Plans or as directed by the Engineer. Each hydrant shall be connected to the main with a 6" ductile iron branch controlled by an independent 6" gate valve. Hydrants shall be installed on concrete support blocks as shown on the Standard Detail Plates, and shall be braced so as to remain plumb during backfill operations. Hydrants shall be thoroughly cleaned of dirt or foreign matter before setting. At locations where hydrant drains will be below the normal water table, the drain openings are to be permanently plugged.

The Contractor shall furnish and install the required number of hydrant protective posts at such special hydrant locations as may be designated by the Engineer. See standard detail for hydrant installation. Protective posts shall be placed as an incidental expense.

Hydrants shall be installed with restrained joints conforming to the requirements of W200.210.

10. Hydrant Drainage Pits

A drainage pit 2' in diameter and 18" deep shall be excavated below each hydrant and filled compactly with coarsely graded gravel or crushed rock under and around the bowl of the hydrant and to a level 6" above the hydrant drainage opening. The stone fill shall be completely covered with an impermeable barrier to prevent backfill from filtering into the drainage pit.

The gravel or crushed rock used for this purpose shall conform to the requirements of City Standard T100.206 "Aggregate for Hydrant Drainage Pit".

11. Plugs

Mechanical joint or slip-on joint plugs shall be inserted into the bells of all dead ends of pipe, tees, and crosses. In all cases, and regardless of the type of plug used or specified, a 3/4" corporation stop shall be tapped into the plug. This Corporation Stop that complies with service

standard specs shall serve to release any accumulated pressure prior to the future removal of the plug.

12. Blocking and Anchoring

Watermain, valves, fittings, plugs and hydrants shall be restrained as shown on the City Standard Detail Plates or as stated in the Special Provisions. As noted in Plate 6-05 (Restrained Joint Detail) tie-rods are only to be used for connections to existing watermain. Joint restraints for new watermain are to be provided by retainer glands, American Fast-Grip or US Pipe Tyton Field Lok gaskets (or approved equal restraining gaskets), or the restrained joint type specifically stated in the Special Provisions. Electrical conductivity is to be maintained across restrained pipe joints.

13. Watermain Within Steel Casings

Watermain installed within a steel casing shall be single gasket, restrained joint type. Electrical conductivity is to be maintained across restrained pipe joints. The watermain shall be mounted on plastic skids, two per length of pipe secured in place to support the pipe along the barrel rather than at the joints. The space between the pipe and casing shall be backfilled and dried sand blown into the space and the ends of the casing shall be sealed with concrete bulkheads at least one foot thick. A 2-inch PVC or copper drain shall extend through the bulkhead at the lower end of the casing.

W200.303 Loading and Disinfection of Watermain

Watermain disinfection shall be done in accordance with AWWA C651. The "Dry Calcium Hypochlorite" method shall be used.

Watermain loading, flushing and bacterial sampling/testing will be done by Rochester Public Utilities personnel. The Contractor is not to operate water distribution system valves or hydrants.

W200.304 Pressure, Leakage and Electrical Conductivity Testing

A. Testing Equipment and Facilities

The Contractor shall provide, at its own expense, all necessary piping and piping connections between the pipe line to be tested, at the point of test thereof, and the nearest available source of supply of acceptable water, together with test pumping equipment, water loss measuring container, pressure gauge, and other equipment, materials and facilities required for and in connection with the specified tests.

Test pressures shall be applied by means of a pump of such design and capacity that the required pressure can be applied and maintained without interruption for the duration of each test. The pressure gauge used shall be tested, accurately calibrated, and approved by Rochester Public Utilities. The container used to measure the volume of water replaced in the water main during the leakage test shall be sized to permit accurate measurement of the pumped replacement water volume (typically less than five gallons).

Rochester Public Utilities will provide the necessary supervision, and the Contractor shall conduct the test at its own expense.

B. Hydrostatic Pressure Test

All pipelines constructed hereunder shall be tested for defective materials and workmanship by being subjected to a hydrostatic test pressure of 150 pounds per square-inch gauge (psig.). Such test pressure shall be assumed to be applied at the lowest point in the line of pipe being tested and the pressure applied at the point of gauge attachment shall be the specified test pressure corrected as necessary to compensate

for any difference in elevation of the gauge above such lowest point in the said line of pipe.

The test pressure shall be applied to watermains only. In the event that any service lines are connected to any watermain that is to be subjected to the test pressure, the curb cocks or other shut-off valves in all such services shall be closed in order that no plumbing be subjected to the specified test pressure. In each case where water service is interrupted for the duration of the hydrostatic tests, the water customer affected thereby shall be notified of the proposed interruption at least one hour before shutting off the water supply.

After the section of the line to be tested has been filled with water, the specified or otherwise authorized test pressure shall be applied and maintained for a period of not less than two hours and for whatever longer period as may be necessary for Rochester Public Utilities to complete the inspection of the line under test and for the Contractor to locate any and all defective joints and pipe line materials.

In the event that repairs are needed, such repairs shall be made, the line refilled as specified, and the test pressure applied as before. This operation shall be repeated until the line and all parts thereof withstand the test pressure in a satisfactory manner.

In special situations, Rochester Public Utilities may approve modifying the hydrostatic test pressure to match the pressure in existing adjacent City Watermains, but in all other respects the test shall be carried out as specified above.

C. Leakage Test

At the discretion and option of Rochester Public Utilities, the leakage test will be taken in cases where deemed necessary or advisable, or it may be waived where the prior observations and testing so indicate. When the leakage test is taken, it shall be conducted in the following manner:

After the specified pressure test has been completed and any and all pipeline repairs have been made and tested to the satisfaction of Rochester Public Utilities, the line or lines being tested shall be subjected to a leakage test under a hydrostatic pressure of 150 pounds per square-inch gauge (psig) as defined in paragraph B above. The pressure shall be maintained constant (within a 5% maximum variation, plus or minus) during the entire time that line leakage measurements are being made, in order that the allowable leakage rate may be determined accurately from the leakage rate formula hereinafter specified (or the included allowable leakage table).

Leakage measurements shall not be started until a constant test pressure has been established. Compression of air trapped in unvented pipes or fittings will give false leakage readings under changing Pressure conditions. After the test pressure has been established and stabilized, the line leakage shall be determined by measuring the volume of water pumped from the measuring container to replace the volume of water leaked from the line being tested.

No pipeline, or tested section thereof, will be accepted unless it has a leakage rate less than or equal to the rate determined by the following formula:

$$L = (S \times D \times P^{1/2}) / 133,200$$

In which,

L = Maximum permissible leakage rate, in gallons per hour.

S = Length of pipe tested, in feet

D = Nominal diameter of the pipe, in inches

P = Average pressure (in psig) during the leakage test (not necessarily the test pressure). This pressure shall be determined by subtracting the average elevation of all tested pipe joints from the elevation of the pressure plane represented by the specified or authorized leakage test pressure, and then converting this difference, in feet or head, to pounds per square-inch hydrostatic pressure. The average pressure may be assumed to be equal to the test pressure where the maximum difference in elevations of the pipe joints being tested does not exceed 20 feet.

In the event that the line or section being tested contains pipe of more than one size, the allowable leakage from all joints of each size shall be calculated separately and then added to obtain the total allowable leakage from the entire line or lines.

The table below summarizes the maximum allowable main leakage (taken from Table 6A, AWWA C600):

Allowable Leakage per 1000 ft of Pipeline, gal/hr*							
Avg Test	Nominal Pipe Diameter, In.						
Pressure, (psi)	4	6	8	12	16	20	24
100	0.30	0.45	0.60	0.90	1.20	1.50	1.80
125	0.34	0.5	0.67	1.01	1.34	1.68	2.01
150	0.37	0.55	0.74	1.10	1.47	1.84	2.21
175	0.40	0.59	0.80	1.19	1.59	1.98	2.38
200	0.43	0.64	0.85	1.28	1.70	2.12	2.55
Normal test pressure is 150 psi.		*Allowable leakage for typical watermain installation.					

Based on 11.65 gpd/mi/in. nominal diameter at a pressure of 150 psi. (AWWA C600)

Where a second pressure test is made following line repairs, the leakage during such test may be measured as a part of the leakage test, provided that where the remainder of the leakage test is made at a reduced pressure as provided herein, the leakage during the application of each of the two pressures shall be measured separately.

It is the intent of this Specification and the Contract based thereon that (a) all joints in piping shall be watertight and free from visible leaks during the prescribed leakage test, and (b) each and every leak that is discovered at any time prior to the expiration of two (2) years from and after the date of final acceptance of the work by the City shall be located and repaired by and at the expense of the Contractor, regardless of any amount that the total line leakage rate during the specified leakage test may be below the specified maximum rate.

If the specified leakage test is made after the pipe line has been backfilled and the joints covered, and such test shows a leakage rate in excess of the permissible maximum, the Contractor shall make all necessary surveys in connection with the location and repair of leaking joints to the extent required to reduce the total leakage to an acceptable amount. Where evidence of leaking joints does not appear on the ground surface above or near the leaks, the Contractor shall prospect the line by sinking a hole, with an auger or otherwise, at the location of each joint and determine any undue saturation of the soil that would indicate a leak at such joint. This prospecting shall be done after pressure has been maintained in the line for a sufficient time to provide adequate soil saturation for locating leaks by this method.

Leaks in mechanical joints shall be repaired by dismantling, cleaning, realigning gland and gasket and rebolting. Under no circumstances shall gland bolts be tightened beyond the specified and allowable torque limits in an attempt to reduce or stop leakage from a defective joint or for any other purpose.

D. Electrical Conductivity Testing

The Contractor shall perform conductivity testing on newly installed watermain in the presence of Rochester Public Utilities personnel within one week after completion of pressure and leakage testing to document electrical conductivity of the watermain.

All watermain, valves, fittings, and hydrants shall be tested for electrical conductivity and current capacity. The test shall be conducted while the watermain is at normal operating pressure. Backfilling shall have been completed. The watermain may be tested in sections of convenient length as approved by Rochester Public Utilities.

Direct a current 315 – 385 amperes shall be passed through the watermain for five minutes. Current flow through the watermain will be measured continuously on a suitable ammeter and shall remain steady without interruption or excessive fluctuation throughout the 5-minute test period.

Insufficient current or intermittent current or arcing, indicated by large fluctuations of the ammeter needle, will be evidence of defective conductivity in the watermain. The cause shall be isolated and corrected. Thereafter, the section in which the defective test occurred shall be retested.

Direct current arc welders will typically be the source of direct current for this testing. Conductivity testing equipment shall be furnished by the Contractor, subject to the approval of Rochester Public Utilities.

Cables from the current source to the section of watermain under test shall be of sufficient size to carry the test current without overheating or excessive voltage drop.

Conductivity testing connections for the test shall be made at fire hydrants. Hydrants used for a test shall be in the open position with the caps on during the test. The cable shall be clamped to the hydrant standpipe and flange bolt. The hydrant-operating nut shall not be used as a terminal during the test.

When conducting a conductivity test, the current control should be set a minimum before starting. After starting the test, gradually increase the current until the current indicated on the ammeter is at the desired test value. Caution: the voltage drop across a defective watermain joint may be in the order of 50-100 volts.

W200.305 Placing Watermain In-Service or Suspension of Service

All water system valve operations are to be done by Rochester Public Utilities personnel.

When it becomes necessary to close off any section of watermain in place or in service for the purpose of making connections to the section in place or for any other purpose, the Contractor shall notify all consumers connected to, and receiving water service from that section of watermain at least one hour in advance of the shutting off of service. Contractor's work, during the suspension of service, shall be so arranged and conducted so as to reduce to a minimum the time necessary for any suspension of existing service. In no case shall existing water service be suspended overnight.

Section 4 METHOD OF MEASUREMENT

W200.401 Watermain

A. General

All items will be measured separately according to design designation as indicated in the pay item name and as may be detailed and defined in the Plans or Special Provisions. Linear measurements of piping will include the running length of any special fittings (tees, wyes, bends, gates, etc.) installed within the line of measure between specified terminal points.

B. Water Pipe

Mainline pipe of each kind and size will be measured separately to the nearest foot, by the overall length along the axis of the pipeline, from beginning to end of each installation and without regard to intervening valves or specials. Terminal points of measure will be the spigot or cut end, base of hub or bell end, center of valves or hydrants, intersecting centers of tee or wye branch service connections, and center of corporation stop or curb stop couplings.

C. Polyethylene Encasement

Polyethylene encasement will be measured separately to the nearest foot by overall length along the axis of the pipeline, from beginning to end of each installation.

W200.402 Special Structures and Appurtenances

Measurement of special structures and appurtenances, specialty construction items such as insulating concrete, sleeves, etc., and certain removal items shall be as stated in the Special Provisions.

W200.403 Valves, Hydrants and Fittings

A. Valves

Valves of each size and type will be measured separately as complete units, including the valve box.

B. Hydrants

Hydrants will be measured by the number of complete units installed.

C. Ductile Iron Fittings

Tees, crosses, plugs, reducers, bends, or other fittings will be measured by the weight of ductile iron fittings. The weight of each fitting will be those listed in AWWA Standard Specification C153, 3-inch through 24-inch and 54" through 64" for water service, and all MJ ends, regardless of the actual weight of fittings installed in the work. Joint materials (glands, gaskets, bolts, nuts, washers, ties rods and other jointing materials) will not be included in fitting weights.

DUCTILE IRON COMPACT MECHANICAL JOINT FITTING TOTAL & OVERSIZE REIMBURSEMENT WEIGHTS (IN POUNDS)												
SIZE	ITEM											
	11 1/4 BEND		22 1/2 BEND		45 BEND		90 BEND		SLEEVE (LONG)		PLUG*	
	TL	OS	TL	OS	TL	OS	TL	OS	TL	OS	TL	OS
4"	16		18		23		27		20		10	
6"	30		32		32		39		36		18	
8"	42		46		46		57		46		26	
10"	58	16	64	18	70	24	89	32	62	16	36	10
12"	74	32	84	38	86	40	108	51	76	30	46	20
14"	130	88	148	102	164	118	210	153	140	94	79	53
16"	158	116	178	132	202	156	264	207	172	126	100	74
20"	245	203	310	264	305	259	400	343	255	209	153	127
24"	315	273	412	366	405	359	565	508	335	289	202	176

SIZE	ITEM					
	TEE		REDUCER		CROSS*	
	TL	OS	TL	OS	TL	OS
4"x4"	32				42	
6"x4"	46		24		62	
6"x6"	56				80	
8"x4"	60		32		84	
8"x6"	72		36		105	
8"x8"	86				111	
10"x4"	78	18	46	14	98	14
10"x6"	90	18	47	11	110	5
10"x8"	105	19	50	50	138	27
10"x10"	120	34			155	44
12"x4"	94	34	58	26	115	31
12"x6"	110	38	60	24	129	24
12"x8"	125	39	60	60	158	47
12"x10"	140	54	64	64	180	69
12"x12"	160	74			212	101
14"x4"	172	112	N/A	N/A	N/A	N/A
14"x6"	182	110	100	64	210	105
14"x8"	206	120	100	100	231	120
14"x10"	228	142	100	100	255	144
14"x12"	234	148	100	100	269	158
14"x14"	280	194			299	188
16"x6"	228	156	124	88	250	145
16"x8"	248	162	124	124	264	153
16"x10"	264	178	124	124	286	175
16"x12"	280	194	124	124	310	199
16"x14"	316	230	140	140	363	252
16"x16"	322	236			410	299

SIZE	ITEM			
	TEE		REDUCER	
	TL	OS	TL	OS
20"x6"	315	243	NA	NA
20"x8"	345	259	NA	NA
20"x10"	370	284	220	220
20"x12"	395	309	205	205
20"x14"	440	354	200	200
20"x16"	465	379	200	200
20"x20"	535	449		
24"x6"	415	343	NA	NA
24"x8"	445	359	NA	NA
24"x10"	470	384	NA	NA
24"x12"	500	414	305	305
24"x14"	550	464	310	310
24"x16"	580	494	320	320
24"x20"	660	574	300	300
24"x24"	720	634		

REFERENCES: AWWA C153/A21.53-94
* Pipe Economy by McWane, Inc. (Clow) copyright 2000

Section 5 BASIS OF PAYMENT

W200.501 Description

Payment for furnishing and installing watermain and appurtenances of each kind and size at the unit price bid shall be compensation in full for all labor, service, and other materials such as rubber ring gaskets, materials for providing electrical conductivity, joint restraint materials, gasket lubricant, glands, bolts and nuts necessary for the satisfactory installation in accordance with the requirements specified and reasonably implied by the Contract, Plans and Specifications.

In the absence of special payment provisions:

1. All costs of furnishing, placing and removing sheeting, shoring, and bracing materials, including the value of materials left in place as required by the Contract, shall be included in the prices bid for pipe installation and will not be compensated for separately.
2. All costs of restoring surface improvements as required, disposal of surplus or waste materials, maintenance and repair of completed work, and final cleanup operations shall be incidental to the Contract Items under which the costs are incurred.

W200.502 Polyethylene Encasement

Payment for polyethylene encasement at the appropriate contract unit price per linear foot shall be compensation in full for all material, equipment, and services necessary for the satisfactory installation of the encasement.

W200.503 Valves, Hydrants and Fittings

Payment for furnishing and installing valves and hydrants at the appropriate contract unit price per unit and fittings at the contract unit price per pound, shall be compensation in full for all costs of the work except those costs for which the proposal contains specific items, subject to the following additional provisions:

1. The cost of furnishing and installing rubber ring gasket, gasket lubricant, glands, bolts and nuts, etc. will be considered as incidental expense with no additional compensation therefore.
2. In the case of valves, the unit price bid shall include furnishing and installing of both the valve and the box.
3. The unit price bid for furnishing and installing tapping sleeve and valve shall be compensation in full for all material, equipment, and services necessary for the satisfactory installation of the sleeve, valve, and box.
4. The unit price bid for furnishing and installing hydrants shall include the hydrants, hydrant extensions and hydrant protective posts, excavation, backfilling and drainage pit construction.
5. Furnishing and installing ¾-inch corporation stops in conjunction with the installation or removal of plugs will be considered incidental expense with no additional compensation therefore.
6. Furnishing and installing of restrained joints (tie rods, retainer glands and single gasket type) will be considered as incidental expense with no additional compensation therefore.

W200.504 Special Structures and Appurtenances

Payment for special structures and appurtenances, specialty construction items such as insulating concrete, sleeves, etc. and certain removal items shall be made as stated in the Special Provisions.

W200.505 Items List

Payment for watermain construction will be made on the basis of the following schedule:

ITEM NO	ITEM	UNIT
W200.511	Furnish & Install " Polyethylene Encasement for " D.I.P.	Linear Foot
W200.514	Furnish & Install " DIP Watermain Class	Linear Foot
W200.515	Furnish & Install " Gate Valve and Box	Linear Foot
W200.516	Furnish & Install " Butterfly Valve & Box	Assembly
W200.517	Furnish & Install " Valve and Box	Assembly
W200.518	Furnish & Install " Pressure Reducing Valve	Each
W200.520	Furnish & Install " x " Tapping Sleeve & Valve	Assembly
W200.525	Furnish & Install " Hydrant	Hydrant
W200.526	Furnish & Install Hydrant Extension	Linear Foot
W200.528	Furnish & Install Water Main Fittings	Pound
W200.530	Furnish & Install " Corporation Stop	Each
W200.535	Furnish & Install " Type Copper Water Pipe	Linear Foot
W200.545	Construct Manhole Type , ' to ' Deep	Structure
W200.550	Remove " Plug	Plug
W200.551	Install " Plug	Plug
W200.552	Install " x " Reducer	Each
W200.553	Remove " Hydrant	Hydrant
W200.554	Install " Hydrant	Hydrant
W200.556	Remove " Gate Valve and Box	Assembly
W200.557	Install " Gate Valve and Box	Assembly
W200.558	Remove Fittings	Each
W200.559	Remove " Watermain	Linear Foot
W200.560	Install " Watermain	Linear Foot
W200.561	Install Watermain Fittings	Each
W200.571	Adjust Gate Valve Box	Each
W200.572	Reconstruct Gate Valve Box	Each
W200.581	Remove & Salvage " Watermain	Linear Foot
W200.582	Remove & Salvage "	Each
W200.590	Turn Off Existing Corporation Stop	Each
W200.591	Lower " Watermain	Linear Foot
W200.599	Street Restoration	Square Yard